

POPULATION OF WEEDS IN A PLANTATION OF RED RASPBERRIES (*RUBUS IDAEUS* L.)

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*Data from monitoring of weed populations are relevant for successful integrated weed management. The purpose of this experiment was to compare the diversity of weed species in red raspberry plantation rows. The red raspberry plantation was established in August 2019. The plantation is located in the south part of Latvia, Zemgale region (N56°33'29.5302", E23°46'26.04"). The red raspberry cultivars 'Daiga', 'Shahrazada', 'Norna', and 'Polana' were grown in the plantation. The bushes were spaced at 0.6 m in rows and 3 m between rows in a plot with size 0.51 ha. Weed infestation in the red raspberry plantation was determined by using the counting method. The counting of weeds and identification of weed species were done three times during the vegetation at the 16th, 22nd, and 30th week of 2021. In total, 34 weed species, including 18 annual and 16 perennial weeds were present in the red raspberry plantation. *Poa annua* (5–60 plants per m²) and *Elytrigia repens* (6–393 plants m²) were found as dominant weeds. During experiment there were differences in weed populations and density between red raspberry cultivars. The cultivar 'Norna' was dominated by perennial weeds, while 'Polana' by annual weeds.*

Keywords: weed incidence, red raspberries.

INTRODUCTION

Weed management in raspberry crops is performed by tillage. Excessive tillage can reduce weed species diversity and increase both soil erosion and production costs (Scursoni *et al.*, 2013). Researchers from Latvia Ņečajeva *et al.* (2015b) reported that the weed species control is necessary to protect crop yields and prevent spread of invasive weeds, while complete eradication of weeds is both impractical and unnecessary. Many weed species interact both among themselves and with other organisms and can be beneficial for the agroecosystem. Weed species diversity has become a concern in the last decades because loss of biodiversity is documented in European countries with intensive agriculture. Loss of weed biodiversity and decline of particular species is associated with increased intensity of agriculture and use of herbicides, as well as reduced diversity of different crops that the weeds are associated with. Abandonment of arable land also causes reduction of rare weed species on

a larger scale (in Europe) (Storkey *et al.*, 2012). Weed species interactions can be beneficial to crops, reducing weed competition. Increased weed diversity without substantial increase of weed density also can be beneficial to other organisms such as arthropods and soil microorganisms (Ņečajeva *et al.*, 2015b). Crop type and crop rotation have been shown as defining factors of weed species composition (Ņečajeva *et al.*, 2015a). Integrated weed management (IWM) is a complex approach to weed control that is based on use of several different methods that complement each other, instead of relying on one single method, like chemical weed control. Weed control methods that can be used as parts of IWM strategy include mechanical weed control, application of herbicides, low tillage, changes in the rate and application time of fertilisers, use of under sown crops and crop rotation (Ņečajeva *et al.*, 2015a). Although weed density and species composition depend to a great extent on climatic and edaphic conditions, crops and associated manage-

ment practices are also important (Pysek *et al.*, 2005; Fried *et al.*, 2008). Climate and environmental change may also alter competitive interactions between agricultural weeds and crops, meaning that, over time, the nature and distribution of the most yield-limiting weeds may change (Fuhrer, 2003). Climate change is clearly recognised as a major driver for increased rates of plant invasion (Diez *et al.*, 2012). Invasive weeds may also result in serious consequences to human health through, for example, increased loads of allergenic pollen (Bradley *et al.*, 2010; Hamaoui-Laguel *et al.*, 2015). In natural ecosystems, non-native weeds have serious negative impacts on biodiversity and ecosystem functioning (Neve *et al.*, 2018).

This study aimed to compare the diversity of weed species in plantation rows of the four most common raspberry cultivars ('Daiga', 'Shahrazada', 'Norna', and 'Polana', which were grown in the Zemgale region farm "Plūģi" in Latvia.

MATERIALS AND METHODS

The red raspberries plantation is located in the south part of Latvia, Zemgale region (GPS-coordinates: N56°33'29.5302", E23°46'26.04"). The plantation was established in October 2019 as a production plantation. The pre-crop was winter oil seed rape. After the pre-crop harvest, mechanical soil tillage was performed — ploughing, tillage, and levelling. In the experiment the summer-fruited red raspberry cultivars ('Daiga', 'Norna', 'Shahrazada') and autumn-fruited red raspberry cultivar ('Polana') were planted as annual shoots in the plantation. Certified plant material of the raspberry cultivars 'Daiga', 'Shahrazada', 'Norna', and 'Polana' were obtained from the orchard located farm "Ķenteni" Ogres region, Ķeipēnu civil parish. All of the cultivars were located in the same area and therefore subjected to the same commercial agronomic practices and environmental conditions. The bushes were spaced at 0.6 m in rows and 3 m between rows in a plot with size 0.51 ha. The beds around the raspberry bushes were weeded by hand two times in the period from 25 April to 1 May 2021 and from 29 May to 30 May 2021 (weeding was performed only under bush strips). Row spacing was performed with a YANMAR F20D tractor equipped with RSB140 cutter, two times (24 May and 19 June 2021). In preparation for the berry harvest on 4 July 2021, the grass between the rows was cut with a mower. Next spring, it is planned to sow a mixed lawn between rows. The pruning of summer red raspberry cultivars was performed during plant dormancy, after the fall development cycle (end of September to beginning of October 2020). At the end of spring cycle, autumn red raspberry cultivar stems were reduced to the height of sub apical buds — 10 cm (March 2021). The massive raspberry varieties 'Daiga' and 'Norna' required additional support.

Soil. Soil in the experimental field was sand clay with an organic matter content of 3.2%, soil reaction pH_{KCl} 7.2, phosphorus content $194 \text{ g} \cdot \text{kg}^{-1}$ and potassium level $161 \text{ g} \cdot \text{kg}^{-1}$.

Meteorological conditions. According to Latvian Environment, Geology and Meteorology data, during the growing season (April to the end of July), the average air temperature was $+13.1^\circ\text{C}$ and the total rainfall in 2021 was about 370 mm.

Weed infestation in the red raspberry plantation was determined by using the counting method, using a $(20 \times 50 \text{ cm})$ 0.1 m^2 frame (frame placed next to a raspberry bush). Weed counts were carried out in 10 places for each raspberry variety, with a frame placed every 20 m. The counting of weeds and identification of weed species were done three times during the vegetation at the 16th (19 April), 22nd (5 June) and 30th (19 July) week of 2021, when the majority of weeds were in the flowering stage and were easier to identify.

Statistical analysis. Data analysis used descriptive statistics indicators, carried out with Microsoft Excel.

RESULTS

The total number of identified weeds in the red raspberry plantation by weed groups is summarised in Figure 1. The highest number of annual weeds was found in the raspberry variety 'Polana' rows at every observation time, while a significantly higher number of perennial weeds was found in the raspberry variety 'Norna' rows. In total, among the four varieties of raspberry plantation 'Daiga', 'Shahrazada', 'Norna', and 'Polana', 34 weed species, including 18 annual and 16 perennial weeds were recorded.

The weed community was dominated by three weed species at each observation time: annual *Poa annua*, *Chenopodium album* (Fig. 2) and perennial *Elytrigia repens* (Fig. 3). Figure 2 shows only those weed species with more than five pcs m^{-2} : *Poa annua*, *Chenopodium album*, *Galium aparine*, *Capsella bursa-pastoris*, *Anagallis arvensis*, *Veronica arvensis*, *Atriplex patula* and *Stellaria media*. The highest number of *Poa annua* was found in the 'Polana' rows at every observation time, while the highest number was found in the 'Polana' and 'Daiga' raspberry cultivars.

In all three weed counts, the most common perennial weed in the rows of red raspberry cultivars 'Daiga', 'Shahrazada',

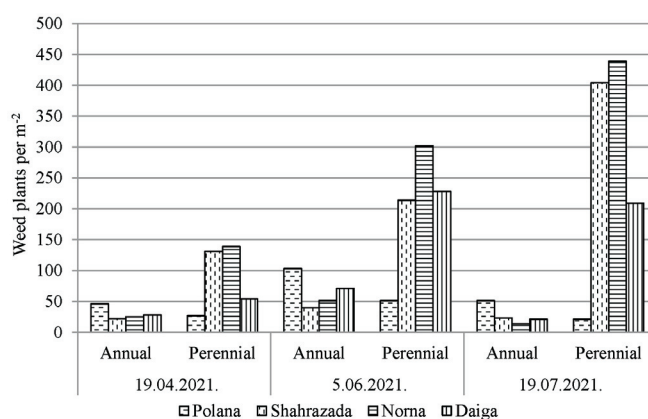


Fig.1. Total number of weeds in biological groups, pcs m^{-2} .

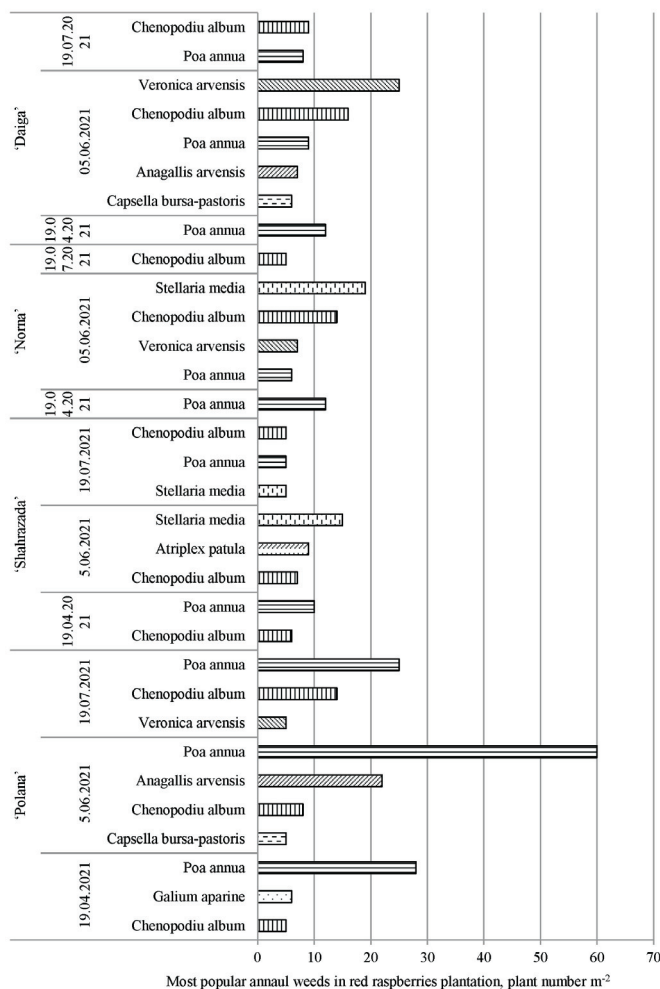


Fig. 2. The most common annual weeds in the raspberry plantation.

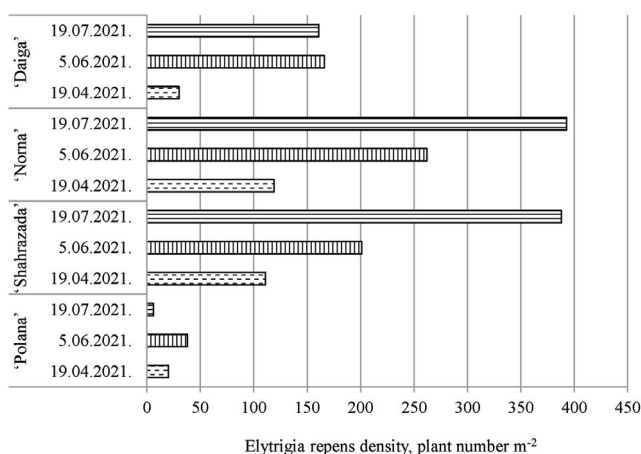


Fig.3. Total number of *Elytrigia repens* in raspberry variety rows during weed counts, pcs m⁻².

'Norna', and 'Polana' was *Elytrigia repens* (Fig. 3). In the plantations of raspberry cultivars 'Polana' and 'Daiga', the smallest number of *Elytrigia repens* was 20 and 30 pcs m⁻² in the first weed count compared to 111 individuals m⁻² of in rows of 'Shahrazada' and 119 pcs m⁻² in rows of 'Norna'. In the second weed count, the lowest number of *Elytrigia repens* (38 pcs m⁻²) was found in 'Polana' rows,

while the number of *Elytrigia repens* in other raspberry cultivars was significantly higher — 201 pcs m⁻² for 'Shahrazada', 'Norna' — 262 pcs m⁻² and 'Daiga' Z — 166 pcs m⁻². The number of *Elytrigia repens* in the 'Shahrazada' and 'Norna' rows also increased significantly during the third weed count. The number of *Elytrigia repens* in the raspberry cultivar 'Norna' rows was 393 pcs m⁻², but in 'Polana' rows decreased to 6 pcs m⁻².

DISCUSSION

There are articles in the literature on bed mulching for raspberries and raspberries in tunnels, but there are practically no articles on raspberry growing in open fields without mulch. In order to be able to choose the most effective weed control method, it is important to determine to which biological group the weeds in the plantation belong, because the control of perennial weeds is more labour-intensive and complicated compared to the control of annual weeds. The increase in the number of *Elytrigia repens* in the raspberry plantation can be explained by the fact that weeds were weeded with a hoe shortly before the second weed census, thus cutting off the existing *Elytrigia repens* weed shoots, which then regenerated with double vigour. It should be noted that *Elytrigia repens* is a rhizome weed that multiplies with underground organs, that may have already been present during the pre-crop sowing. Therefore, it is important to conduct weed control after pre-crop harvesting and to know the after-crop choose as the most successful method of weed control, because raspberry is a perennial crops and soil is not distributed every year. When weeding with a hoe, it must be taken into account that raspberry bushes can also be injured, and like any crop, raspberry does not compete well with perennial weeds.

CONCLUSIONS

1. It was found that in total 34 weed species, including 18 annual and 16 perennial weeds were present in the red raspberry plantation.
2. *Poa annua* (5–60 pcs m⁻²) and *Elytrigia repens* (6–393 pcs m⁻²) were found as dominant weeds.
3. In the red raspberry plantation, there were differences in the weed community and density between red raspberry cultivars. The cultivar 'Norna' was dominated by perennial weeds, while 'Polana' by annual weeds.
4. Due to the great diversity of weed species and the prevalence of perennial weeds, in particular *Elytrigia repens*, it is necessary to mulch the tree beds.
5. Soil properties also need to be included in future analysis. Weed diversity was positively related to weed density, such that detailed understanding of the way field management and other factors influence arable red raspberry cultivars is needed to maintain the diversity of weed flora, at the same time achieving adequate weed control.

6. The article includes the results of one year of research. The ongoing study should be continued to obtain more complete results. This may pave the way for new work on sustainable weed control in perennial crops.

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NEZĀĻU IZPLATĪBA SARKANO AVEŅU (*RUBUS IDAEUS* L.) STĀDĪJUMĀ

Nezāļu izplatības monitoringa dati ir svarīgi veiksmīgai integrētai nezāļu ierobežošanai. Pētījuma mērķis bija salīdzināt nezāļu sugu daudzveidību sarkano aveņu stādījumā rindās. Sarkanās avenes iestādītas 2019. gada augustā. Stādījums atrodas Latvijas dienvidu daļā, Zemgales reģionā (N56°33'29.5302", E23°46'26.04"). Stādījumā tiek audzētas četras aveņu šķirnes: 'Daiga', 'Shahrazada', 'Norna' un 'Polana'. Aveņu stādījumu rindu platums — 3 m un attālums starp stādiem 0.6 m, kopējā platība 0.51 ha. Nezāļu uzskaitē veikta, izmantojot skaita metodi, nosakot sastopamās nezāļu sugas. Nezāļu uzskaitē veikta trīs reizes 2021. gada veģetācijas sezonā (16., 22. un 30. nedēļā). Starp aveņu stādījuma šķirnēm konstatētas 34 nezāļu sugas, no tām 18 īsmūža un 16 daudzgadīgās. Dominējošās nezāles: maura skarene *Poa annua* (5–60 gab. m⁻²) un ložņu vārpata *Elytrigia repens* (6–393 gab. m⁻²). Starp sarkano aveņu šķirnēm novērojama nezāļu izplatības un blīvuma atšķirības. Šķirnes 'Norna' stādījumā dominēja daudzgadīgās nezāles, savukārt 'Polana' stādījumā — īsmūža nezāles.